

## INTERACTIVE DISPLAY WITH TACTILE FEEDBACK

### RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 12/849,530, filed Aug. 3, 2010, entitled Interactive Display with Tactile Feedback, which is a non-provisional of U.S. Provisional Patent Application 61/353,509, filed Jun. 10, 2010, and a continuation-in-part of U.S. patent application Ser. No. 12/759,410, entitled Energy Efficient Interactive Display With Energy Regenerative Keyboard, filed Apr. 13, 2010, which is a continuation-in-part of U.S. patent application Ser. No. 12/339,721, entitled Apparatus and Method for Interactive Display With Tactile Feedback, filed Dec. 19, 2008, which is a continuation-in-part of U.S. patent application Ser. No. 12/142,624, entitled Apparatus and Method for Interactive Display With Tactile Feedback, filed Jun. 19, 2008, the contents of which are incorporated herein by reference in their entirety.

### FIELD OF THE INVENTION

[0002] The present invention relates to interactive displays for electronic devices, and in particular to an interactive display that provide tactile feedback to a user when the user applies pressure to the interactive display.

### SUMMARY OF THE INVENTION

[0003] An electronic device according to an exemplary embodiment of the present invention comprises: a housing comprising a first surface and a second surface; an interactive display having a keyboard-enabled mode and a keyboard-disabled mode, the interactive display comprising: a first image display device disposed at the first surface that displays image data; and a physical keypad disposed at the second surface that provides tactile feedback to a user only when the interactive display is in the keyboard-enabled mode, the physical keypad being substantially smooth when the interactive display is in the keyboard-disabled mode.

[0004] In at least one embodiment, the first image display device displays an imaged keypad comprising imaged keys when the interactive display is in the keyboard-enabled mode.

[0005] In at least one embodiment, the electronic device further comprises a second image display device disposed at the second surface.

[0006] In at least one embodiment, the physical keypad disposed at the second surface comprises one or more physical keys that control activation of the imaged keys within the imaged keypad.

[0007] In at least one embodiment, the physical keypad disposed at the second surface comprises one or more physical keys that perform a different function from the one or more imaged keys of the imaged keypad.

[0008] In at least one embodiment, the electronic device further comprises a sensor that detects user interaction with the physical keypad disposed on the second surface; and an image generator that displays within the first image display device an imaged representation of the user interaction with the physical keypad disposed on the second surface.

[0009] In at least one embodiment, the sensor comprises one or more of the following sensor types: a motion sensor, a thermal sensor and a pressure sensor.

[0010] In at least one embodiment, the imaged representation of the user interaction comprises an imaged depiction of the user's finger or thumb interacting with the imaged keypad.

[0011] In at least one embodiment, the first and second surfaces are opposite from one another.

[0012] In at least one embodiment, the first and second surfaces are angled relative to one another.

[0013] In at least one embodiment, the first and second surfaces are adjacent to one another.

[0014] In at least one embodiment, the physical keypad comprises piezoelectric material.

[0015] In at least one embodiment, the piezoelectric material is quartz.

[0016] In at least one embodiment, the physical keypad comprises magnetostrictive material.

[0017] In at least one embodiment, the image display device is selected from one of the following types of image display devices: liquid crystal displays, digital light processor displays, plasma displays and light emitting diode displays.

[0018] In at least one embodiment, the electronic device is selected from one of the following types of electronic devices: cell phones, personal digital assistants, gaming devices, e-books, automatic teller machines and data input devices.

[0019] An electronic device according to an exemplary embodiment of the present invention comprises: a housing comprising a first surface and a second surface; and an interactive display having an interactive mode and a non-interactive mode, the interactive display comprising: an image display device disposed at the first surface of the housing that displays a user-interactive imaged keypad in at least a portion of the image display device when the interactive display is in the interactive mode and that displays other image data in the at least a portion of the image display device when the interactive display is in the non-interactive mode; a substantially transparent physical keypad disposed at the second surface of the housing that provides tactile feedback to a user indicating location of keys within the imaged keypad; a sensor that detects user interaction with the physical keypad; and an image generator that displays an imaged representation of the user interaction with the physical keypad within the imaged keypad.

[0020] In at least one embodiment, the sensor comprises one or more of the following sensor types: a motion sensor, a thermal sensor and a pressure sensor.

[0021] In at least one embodiment, the imaged representation of the user interaction comprises an imaged depiction of the user's finger or thumb interacting with the imaged keypad.

[0022] An electronic device according to an exemplary embodiment of the present invention comprises: an interactive display having an interactive mode and a non-interactive mode, the interactive display comprising: an image display device that displays a user-interactive imaged keypad in at least a portion of the image display device when the interactive display is in the interactive mode and that displays other image data in the at least a portion of the image display device when the interactive display is in the non-interactive mode; and a substantially transparent physical keypad that provides tactile feedback to a user indicating